Marking Scheme

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Secondary School Supplementary Examination, July- 2023

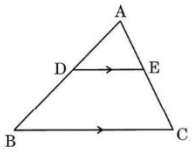
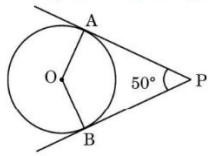
SUBJECT NAME: Mathematics (Basic) SUBJECT CODE 241 PAPER CODE 430/C/3

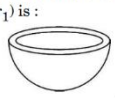
General Instructions: -

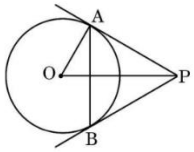
1	You are aware that evaluation is the most important process in the actual and correct assessment of the candidates. A small mistake in evaluation may lead to serious problems which may affect the future of the candidates, education system and teaching profession. To avoid mistakes, it is requested that before starting evaluation, you must read and understand the spot evaluation guidelines carefully.
2	**"Evaluation policy is a confidential policy as it is related to the confidentiality of the examinations conducted, Evaluation done and several other aspects. Its' leakage to public in any manner could lead to derailment of the examination system and affect the life and future of millions of candidates. Sharing this policy/document to anyone, publishing in any magazine and printing in News Paper/Website etc may invite action under various rules of the Board and IPC."**
3	Evaluation is to be done as per instructions provided in the Marking Scheme. It should not be done according to one's own interpretation or any other consideration. Marking Scheme should be strictly adhered to and religiously followed. **However, while evaluating, answers which are based on latest information or knowledge and/or are innovative, they may be assessed for their correctness otherwise and due marks be awarded to them. In class-X, while evaluating two competency-based questions, please try to understand given answer and even if reply is not from marking scheme but correct competency is enumerated by the candidate, due marks should be awarded.**
4	The Marking scheme carries only suggested value points for the answers.These are in the nature of Guidelines only and do not constitute the complete answer. The students can have their own expression and if the expression is correct, the due marks should be awarded accordingly.
5	The Head-Examiner must go through the first five answer books evaluated by each evaluator on the first day, to ensure that evaluation has been carried out as per the instructions given in the Marking Scheme. If there is any variation, the same should be zero after delibration and discussion. The remaining answer books meant for evaluation shall be given only after ensuring that there is no significant variation in the marking of individual evaluators.
6	Evaluators will mark(√) wherever answer is correct. For wrong answer CROSS 'X" be marked. Evaluators will not put right (✓) while evaluating which gives an impression that answer is correct and no marks are awarded. **This is most common mistake which evaluators are committing.**
7	If a question has parts, please award marks on the right-hand side for each part. Marks awarded for different parts of the question should then be totaled up and written in the left-hand margin and encircled. This may be followed strictly.
8	If a question does not have any parts, marks must be awarded in the left-hand margin and encircled. This may also be followed strictly.

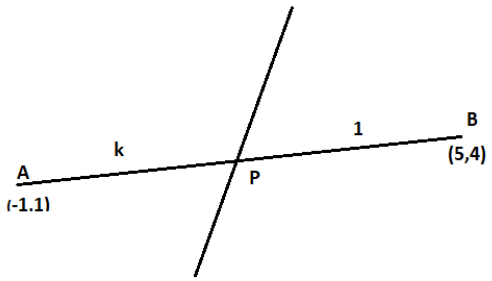
9	If a student has attempted an extra question, answer of the question deserving more marks should be retained and the other answer scored out with a note **"Extra Question"**.
10	No marks to be deducted for the cumulative effect of an error. It should be penalized only once.
11	A full scale of marks _____80_____(example 0 to 80/70/60/50/40/30 marks as given in Question Paper) has to be used. Please do not hesitate to award full marks if the answer deserves it.
12	Every examiner has to necessarily do evaluation work for full working hours i.e., 8 hours every day and evaluate 20 answer books per day in main subjects and 25 answer books per day in other subjects (Details are given in Spot Guidelines).
13	Ensure that you do not make the following common types of errors committed by the Examiner in the past:- Giving more marks for an answer than assigned to it. ● Wrong totaling of marks awarded on an answer. ● Wrong transfer of marks from the inside pages of the answer book to the title page. Wrong question wise totaling on the title page. ● Leaving answer or part thereof unassessed in an answer book. ● ● Wrong totaling of marks of the two columns on the title page. ● Wrong grand total. ● Marks in words and figures not tallying/not same. ● Wrong transfer of marks from the answer book to online award list. ● Answers marked as correct, but marks not awarded. (Ensure that the right tick mark is correctly and clearly indicated. It should merely be a line. Same is with the X for incorrect answer.) ● Half or a part of answer marked correct and the rest as wrong, but no marks awarded.
14	While evaluating the answer books if the answer is found to be totally incorrect, it should be marked as cross (X) and awarded zero (0)Marks.
15	Any un assessed portion, non-carrying over of marks to the title page, or totaling error detected by the candidate shall damage the prestige of all the personnel engaged in the evaluation work as also of the Board. Hence, in order to uphold the prestige of all concerned, it is again reiterated that the instructions be followed meticulously and judiciously.
16	The Examiners should acquaint themselves with the guidelines given in the "**Guidelines for spot Evaluation**" before starting the actual evaluation.
17	Every Examiner shall also ensure that all the answers are evaluated, marks carried over to the title page, correctly totaled and written in figures and words.
18	The candidates are entitled to obtain photocopy of the Answer Book on request on payment of the prescribed processing fee. All Examiners/Additional Head Examiners/Head Examiners are once again reminded that they must ensure that evaluation is carried out strictly as per value points for each answer as given in the Marking Scheme.

	MARKING SCHEME MATHEMATICS (BASIC) 430/C/3	
Q.NO	**Expected Answer/Value Points**	**Distribution of Marks**
	SECTION A *This section comprises multiple choice questions (MCQs) of 1 mark each.*	
1	Two cubes each of 5 cm edge are joined end to end. The surface area of the resulting cuboid is : (a) 200 cm^2 (b) 300 cm^2 (c) 125 cm^2 (d) 250 cm^2	
Answer	(d) 250 cm^2	1
2	The distance between the points (c, 0) and (0, – c) is : (a) $c\sqrt{2}$ units (b) 2c units (c) $2\sqrt{c}$ units (d) c units	
Answer	(a) $c\sqrt{2}$ units	1
3	The roots of the quadratic equation $x^2 + px - q = 0$ are equal, if : (a) $p^2 = 4q$ (b) $p^2 = -4q$ (c) $p^2 = 2q$ (d) $p^2 = -2q$	
Answer	(b) $p^2 = -4q$	1
4	The HCF of two numbers is 27 and their LCM is 162. If one of the numbers is 54, the other number is : (a) 36 (b) 45 (c) 9 (d) 81	
Answer	(d) 81	1
5	At some time of the day, the height and length of the shadow of a man are equal. The sun's altitude is : (a) 30° (b) 45° (c) 60° (d) 90°	
Answer	(b) 45^0	1

6	In $\triangle ABC$, $DE \parallel BC$. If $AD : DB = 2 : 3$, then $DE : BC$ is equal to :  (a) 2 : 3 (b) 3 : 5 (c) 2 : 5 (d) 3 : 2	
Answer	(c) 2 : 5	1
7	If common difference of an A.P. is -6, then value of $a_{20} - a_{14}$ is : (a) 36 (b) 6 (c) -36 (d) -6	
Answer	(c) -36	1
8	In the given figure, PA and PB are tangents to a circle centred at O. If $\angle APB = 50°$, then $\angle AOB$ is equal to :  (a) 130° (b) 50° (c) 120° (d) 90°	
Answer	(a)130^0	1
9	For the following distribution Marks below / Number of Students 10 / 1 20 / 5 30 / 13 40 / 15 50 / 16 the modal class is : (a) $30 - 40$ (b) $40 - 50$ (c) $20 - 30$ (d) $10 - 20$	
Answer	(c) 20-30	1
10	If $\text{cosec } A = \frac{7}{5}$, then value of $\tan A \cdot \cos A$ is : (a) $\frac{7}{5}$ (b) $\frac{2\sqrt{6}}{5}$ (c) $\frac{24}{49}$ (d) $\frac{5}{7}$	
Answer	(d) $\frac{5}{7}$	1

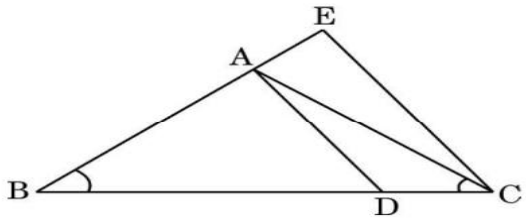
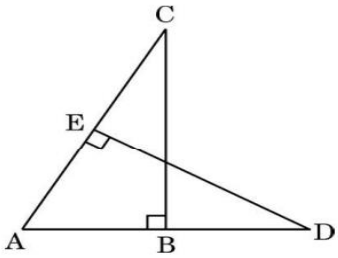
11	A quadratic polynomial having zeroes – 6 and 0 is : (a) $x(x^2 + 6)$ (b) $6x(x + 6)$ (c) $6x^2 - 1$ (d) $6(x^2 - x)$	
Answer	(b) 6x(x+6)	1
12	Area of a segment of a circle of radius r and central angle 90° is : (a) $\frac{\pi r^2}{2} - \frac{1}{2}r^2$ (b) $\frac{2\pi r}{4} - \frac{1}{2}r^2$ (c) $\frac{\pi r^2}{4} - \frac{1}{2}r^2$ (d) $\frac{2\pi r}{4} - r^2 \sin 90°$	
Answer	(c) $\frac{\pi r^2}{4} - \frac{1}{2}r^2$	1
13	If $x = a \sin\theta$ and $y = b \cos\theta$, then $b^2x^2 + a^2y^2$ is equal to : (a) 1 (b) a^2b^2 (c) $\frac{a^2 + b^2}{a^2b^2}$ (d) $a^2 + b^2$	
Answer	(b) a^2b^2	1
14	The pair of linear equations $5x + 4y = 20$ and $10x + 8y = 16$ has : (a) no solution (b) infinite number of solutions (c) a unique solution (d) two solutions	
Answer	(a) no solution	1
15	Degree of a zero polynomial is : (a) 0 (b) 1 (c) any real number (d) not defined	
Answer	(d) not defined	1
16	Total surface area (internal and external) of a hemispherical bowl having radii r_1 and r_2 ($r_2 > r_1$) is :  (a) $2\pi(r_1^2 + r_2^2)$ (b) $\pi(r_1^2 + r_2^2)$ (c) $3\pi r_2^2 + \pi r_1^2$ (d) $3\pi r_1^2 + \pi r_2^2$	
Answer	(c) $3\pi r_2^2 + \pi r_1^2$	1

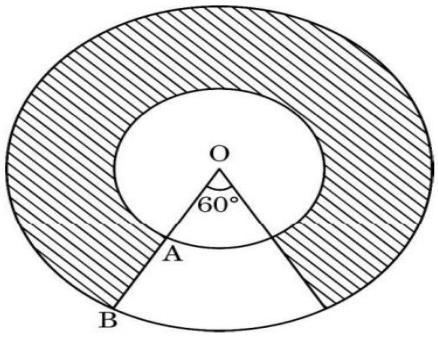
17	The probability that a month of 30 days has 5 Sundays, is (a) $\frac{1}{7}$ (b) $\frac{2}{7}$ (c) $\frac{1}{15}$ (d) $\frac{5}{30}$	
Answer	(b) $\frac{2}{7}$	
18	If the mean and the mode of a distribution are 17 and 20 respectively, then the median of the distribution, using empirical formula, is : (a) 20 (b) $\frac{31}{3}$ (c) 18 (d) 17	
Answer	(c) 18	1
19	*Questions number **19** and **20** are Assertion and Reason based questions carrying 1 mark each. Two statements are given, one labelled as Assertion (A) and the other is labelled as Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.* (a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A). (b) Both Assertion (A) and Reason (R) are true, but Reason (R) is ***not*** the correct explanation of the Assertion (A). (c) Assertion (A) is true, but Reason (R) is false. (d) Assertion (A) is false, but Reason (R) is true. *Assertion (A) :* An event is very likely to happen if its probability is 0·9999. *Reason (R) :* Probability of a sure event is always 1.	
Answer	(b) Both Assertion (A) and Reason (R) are true, but Reason (R) is **not** the correct explanation of the Assertion (A).	1
20	*Assertion (A) :* PA and PB are tangents to the circle centred at O and $\angle OPA = 30°$. Then, ΔPAB is an equilateral triangle. *Reason (R) :* Lengths of tangents from an external point to a circle are equal in length. 	
Answer	(a) Both Assertion (A) and Reason (R) are true, and Reason (R) is the correct explanation of the Assertion (A).	1

	SECTION B *This section comprises very short answer (VSA) type questions of 2 marks each.*	
21	**Three coins are tossed together.** **(i) Write all possible outcomes.** **(ii) Find the probability of having at most 2 heads.**	
Solution	i) HHH, HHT, HTH, THH, HTT, THT, TTH, TTT ii) P (at most 2 heads) = $\frac{7}{8}$	1 1
22	Find the centre and radius of a circle having end points of its diameter as $(3, -10)$ and $(1, 4)$.	
Solution	Centre = $\left(\frac{3+1}{2}, \frac{-10+4}{2}\right) = (2, -3)$ Radius = $\sqrt{(2-1)^2+(-3-4)^2} = \sqrt{50} = 5\sqrt{2}$ units.	1 1
23	**Find the ratio in which a line segment joining the points $(-1, 1)$ and $(5, 4)$ is divided by the y-axis.**	
Solution	Let the ratio be k:1  Point P is $\left(\frac{5k-1}{k+1}, \frac{4k+1}{k+1}\right)$ P lies on y- axis so x = 0 $\frac{5k-1}{k+1}=0$ $\Rightarrow k = \frac{1}{5}$ ∴ P divides AB in the ratio 1:5	1+ ½ ½

24(a)	Show that 12^n can never end with a digit 0, where 'n' is a natural number.	
Solution (a)	$12^n = (2\times 2\times 3)^n$ For a number to end with zero it should have both 2 and 5 as its prime factors but 12^n has only prime numbers 2 and 3 as its factors so it can not end with zero.	1 1
(b)	**OR** Give example of two irrational numbers whose (i) sum is a rational number. (ii) product is an irrational number.	
Solution (b)	(i) Any relevant example. (ii) Any relevant example.	1 1
25(a)	**For A = 30° and B = 60°, verify that** $\tan(B-A) = \frac{\tan B - \tan A}{1+\tan A \tan B}$	
Solution (a)	$LHS = \tan(60^0-30^0) = \tan 30^0 = 1/\sqrt{3}$ $RHS = \frac{\tan 60^0 - \tan 30^0}{1+\tan 60^0 \tan 30^0}$ $= \frac{\sqrt{3}-\frac{1}{\sqrt{3}}}{1+\sqrt{3}\left(\frac{1}{\sqrt{3}}\right)} = \frac{1}{\sqrt{3}}$ $\therefore$ LHS = RHS	$\frac{1}{2}$ $1+\frac{1}{2}$
(b)	**OR** Evaluate : $\sin^2 60° - 2\cos^2 45° + \frac{1}{2}\operatorname{cosec}^2 30°$	
Solution (b)	$\sin^2 60^0 - 2\cos^2 45^0 + \frac{1}{2}\cos ec^2 30^0 = \left(\frac{\sqrt{3}}{2}\right)^2 - 2\left(\frac{1}{\sqrt{2}}\right)^2 + \frac{1}{2}(2)^2$ $= \frac{7}{4}$	$1\frac{1}{2}$ $\frac{1}{2}$

	SECTION C *This section comprises short answer (SA) type questions of 3 marks each.*	
26	Sum of the areas of two squares is 468 m^2. If the difference between their sides is 6 m, then find the sides of the two squares.	
Solution	Let the sides of the two squares be x and x+6. A.T.Q. $x^2 + (x+6)^2 = 468$ $\Rightarrow 2x^2+12x - 432= 0$ or $x^2 + 6x - 216 = 0$ $\Rightarrow (x+18)(x-12) = 0$ $\Rightarrow x = 12$ or $x = -18$ (rejecting) Sides of two squares are 12 m and 18 m.	1 $1\frac{1}{2}$ $\frac{1}{2}$
27(a)	**Prove that $2 + 3\sqrt{3}$ is an irrational number. It is given that $\sqrt{3}$ is an irrational number.**	
Solution (a)	Let us assume that $2 + 3\sqrt{3}$ is a rational number $2 + 3\sqrt{3} = \frac{p}{q}$; p, q are integers and $q \neq 0$ $\Rightarrow \sqrt{3} = \frac{p-2q}{3q}$ RHS is rational but LHS is irrational $\therefore$ Our assumption is wrong. Hence $2 + 3\sqrt{3}$ is an irrational number	1 1 1
(b)	OR Prove that $\sqrt{5}$ is an irrational number	
Solution (b)	Let us assume that $\sqrt{5}$ is a rational number $\sqrt{5} = \frac{p}{q}$; p, q are coprime and $q \neq 0$ $\sqrt{5}q = p \Rightarrow 5q^2 = p^2$ ----------(i) p^2 is divisible by 5. So, p is divisible by 5. $p = 5c \Rightarrow p^2 = 25c^2$ ----------(ii) Putting p^2 in eqn.(i) $\Rightarrow q^2 = 5c^2$. So, q is divisible by 5. Thus, p and q have a common factor 5, which is a contradiction $\therefore$ our assumption is incorrect. Therefore, $\sqrt{5}$ is an irrational number.	1 ½ 1 ½

28(a)	In the given figure, $\frac{BC}{BD} = \frac{BE}{AC}$ and $\angle ABD = \angle ACD$. Show that $\Delta ABD \sim \Delta EBC$.  	
Solution (a)	$\angle ABD = \angle ACD \Rightarrow$ AB = AC $\therefore \frac{BC}{BD} = \frac{BE}{AC} \Rightarrow \frac{BC}{BD} = \frac{BE}{BA}$ $\angle B = \angle B$ (common) $\therefore$ $\Delta ABD \backsim \Delta EBC$ [SAS similarity criterion]	1 1 1
(b)	**OR** In the given figure, ABC and AED are two right triangles, right angled at B and E respectively. Prove that :  (i) $\Delta ABC \sim \Delta AED$ (ii) $AB \times AD = AC \times AE$	
Solution (b)	(i) In ΔABC and ΔAED, $\angle ABC = \angle AED = 90^0$ [Given] $\angle BAC = \angle EAD$ [common angles] $\therefore \Delta ABC \sim \Delta AED$ [AA similarity criterion] (ii) $\Delta ABC \sim \Delta AED$ $\Rightarrow \frac{AB}{AE} = \frac{AC}{AD}$ (Corresponding sides of similar triangles are proportional) $\Rightarrow AB \times AD = AC \times AE$	$1\frac{1}{2}$ 1 $\frac{1}{2}$

29	In the given figure, two concentric circles are shown, centred at O. The radii of the circles are OA = 3 cm and OB = 6 cm.  Find perimeter of the shaded region. (Use $\pi = 3{\cdot}14$)	
Solution	Let R and r be the radii of the outer and inner circles. Perimeter of the shaded region $= \frac{\theta 2\pi R}{360} + \frac{\theta 2\pi r}{360} + 2(R - r)$ $= \frac{300\times 2\times 3.14}{360} \times (6+3) + 2 \times (6-3)$ $= 47.10 + 6 \quad = 53.1$ cm	2 1
30	Prove that : $\frac{\cot^2\theta\,(\sec\theta - 1)}{1+\sin\theta} = \sec^2\theta\,\frac{(1-\sin\theta)}{(\sec\theta+1)}$	
Solution	$L.H.S = \frac{\frac{\cos^2\theta}{\sin^2\theta}\left(\frac{1}{\cos\theta}-1\right)}{1+\sin\theta} = \frac{\cos\theta}{(1+\cos\theta)(1+\sin\theta)}$ $R.H.S = \frac{1}{\cos^2\theta}\times\frac{(1-\sin\theta)\cos\theta}{1+\cos\theta} = \frac{(1-\sin\theta)\cos\theta}{(1-\sin^2\theta)(1+\cos\theta)}$ $= \frac{\cos\theta}{(1+\cos\theta)(1+\sin\theta)}$ $\therefore$ L.H.S = R.H. S	1+ ½ 1 ½
31	Find the zeroes of the quadratic polynomial $8x^2 + 3x - 5$ and verify the relationship between the zeroes and the coefficients.	
Solution	$8x^2+3x-5$ $= (x+1)(8x-5)$ $\therefore x = -1$ and $x = \frac{5}{8}$ are the zeroes of the polynomial Sum of zeroes $= \frac{-3}{8} = -\frac{coefficient\ of\ x}{coefficient\ of\ x^2}$ Product of zeroes $= \frac{-5}{8} = \frac{constant\ term}{coefficient\ of\ x^2}$	1 1 ½ ½

SECTION D

This section comprises long answer (LA) type questions of 5 marks each.

32 (a) **The following table gives production yield per hectare of wheat of 100 farms of a village :**

Production yield (in kg/ha)	Number of farms
50 – 55	2
55 – 60	8
60 – 65	12
65 – 70	24
70 – 75	38
75 – 80	16

Find the mean and median of the data.

Solution (a)

Class	x_i	f_i	$u_i = \frac{x_i - 67{\cdot}5}{5}$	f_iu_i	cf
50 – 55	52·5	2	– 3	– 6	2
55 – 60	57·5	8	– 2	– 16	10
60 – 65	62·5	12	-1	-12	22
65 – 70	67·5	24	0	0	46
70 – 75	72·5	38	1	38	84
75 – 80	77·5	16	2	32	100
		100		36	

2 for correct table

$$\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$$

$$= 67{\cdot}5 + \left(\frac{36}{100} \times 5\right) = 69{\cdot}3$$

$1+\frac{1}{2}$

$$\text{Median} = l + \frac{\frac{N}{2} - cf}{f} \times h$$

$$= 70 + \frac{50-46}{38} \times 5 = 70.5$$

$1+\frac{1}{2}$

(b)

OR

Find the mean and the mode of the data given below :

Weight (in kg)	Number of students
40 – 45	5
45 – 50	11
50 – 55	20
55 – 60	24
60 – 65	28
65 – 70	12

Solution (b)

Class	x_i	f_i	$u_i = \frac{x_i - 57{\cdot}5}{5}$	f_iu_i
40 – 45	42·5	5	– 3	– 15
45 – 50	47·5	11	– 2	– 22
50 – 55	52·5	20	-1	-20
55 – 60	57·5= a	24	0	0
60 – 65	62·5	28	1	28
65 – 70	67·5	12	2	24
		100		-5

$1\frac{1}{2}$ for correct table

$$\text{Mean} = a + \frac{\Sigma f_i u_i}{\Sigma f_i} \times h$$

$$= 57.5 + \left(\frac{-5}{100} \times 5\right) = 57.25$$

1+ ½

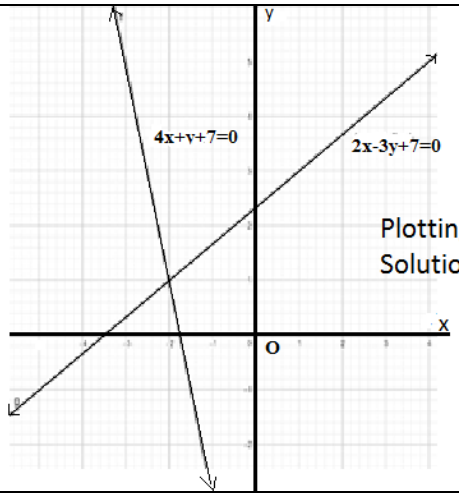
$$\text{Mode} = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2}\right) \times h$$

$$= 60 + \frac{28-24}{2(28)-24-12} \times 5 = 61$$

1½ +½

33(a) Solve the pair of linear equations $4x + y + 7 = 0$ and $2x - 3y + 7 = 0$ graphically.

Solution (a)

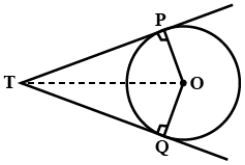
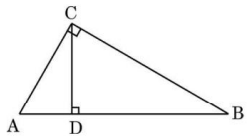


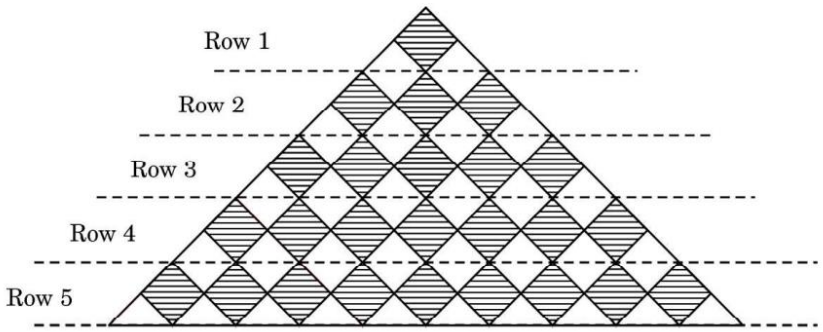
Plotting the graph of each line

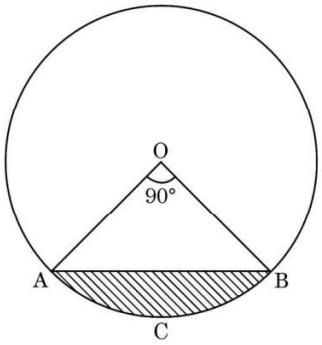
Solution: x= -2 and y=1

2+2

1

(b)	**OR** 7 chairs and 4 tables for a classroom together cost ₹ 7,000; while 5 chairs and 3 tables together cost ₹ 5,080. Find the cost of each chair and each table.	
Solution (b)	Let the cost of one chair be ₹ x and that of one table be ₹ y 7x+4y=7000 ----------(i) 5x+3y=5080 ----------(ii) Solving (i) and (ii) x = 680 and y = 560 Cost of each chair = ₹ 680 and cost of each table = ₹ 560	1 ½ 1 ½ 1+1
34	Prove that the lengths of the tangents drawn from an external point to a circle are equal.	
Solution	 Given : TP and TQ are two tangents drawn from an external point T to the circle C(O,r) To prove: TP = TQ Proof : In Δ OPT and Δ OQT OT = OT (common) ∠OPT = ∠OQT = 90⁰ (Tangent and radius are perpendicular at point of contact) OP = OQ (radii of the same circle) ∴ Δ OPT ≅ Δ OQT (RHS congruence) ∴ TP = TQ (by c.p.c.t) So, length of the tangents drawn from an external point to circle are equal.	1 for figure 1 2 1
35	In the given figure, ∠ ACB = 90° and CD ⊥ AB. Prove that $CD^2 = BD \times AD$.  	
Solution	$Let \angle A = \theta$ $\Rightarrow \angle ACD = 90^0 - \theta \therefore \angle BCD = \theta$ ----------(i) $\therefore In\ \Delta CDA\ and\ \Delta BDC$ $\angle A = \angle BCD$ (using (i)) $\angle CDA = \angle BDC = 90^0$ $\therefore \Delta CDA \square \Delta BDC$ [AA similarity criterion]	1 2

	$\therefore \frac{CD}{BD} = \frac{DA}{DC}$ $\Rightarrow CD^2 = BD \times DA$	1 1
	SECTION E *This section comprises 3 case study based questions of 4 marks each.*	
36	**Case Study – 1** A fashion designer is designing a fabric pattern. In each row, there are some shaded squares and unshaded triangles.  Based on the above, answer the following questions : (i) Identify A.P. for the number of squares in each row. *1* (ii) Identify A.P. for the number of triangles in each row. *1* (iii) (a) If each shaded square is of side 2 cm, then find the shaded area when 15 rows have been designed. *2* **OR** (iii) (b) Write a formula for finding total number of triangles in 'n' number of rows. Hence, find S_{10}. *2*	
Solution	(i) A.P. for the number of squares in each row is 1, 3, 5, 7, 9.... (ii) A.P. for the number of triangles in each row is 2, 6, 10, 14.... (iii) (a) Area of each square = $2 \times 2 = 4$ cm^2 Number of squares in 15 rows = $\frac{15}{2}(2+14\times 2)$ =225 Shaded area = 225×4 =900 cm^2 **OR**	1 1 $\frac{1}{2}$ 1 $\frac{1}{2}$

	(b) $S_n = \frac{n}{2}[4+(n-1)4] = 2n^2$	1
	$\therefore S_{10} = 2\times10^2 = 200$	1
37	**Case Study – 2** **Age of a tree** : The most accurate way to determine the age of a tree is to count the annual rings of wood growth. One such trunk has been shown here.  To make an identification mark, the forest department has painted segment ACBA. (See diagram) If chord AB makes an angle 90° at the centre and radius of the trunk is 21 cm, then find the :  (i) length of chord AB. *1* (ii) area of Δ OAB. *1* (iii) (a) area of segment ACBA. *2* **OR** (iii) (b) perimeter of sector OACBO. *2*	
Solution	(i) AB = $\sqrt{21^2+21^2} = 21\sqrt{2}$ cm	1
	(ii) Area of $\Delta OAB = \frac{1}{2}\times21\times21 = 220.5$ cm^2	1
	(iii) (a) Area of segment ACBA = $\frac{1}{4}\times\frac{22}{7}\times21\times21 - 220.5$ = 126 cm^2.	1 ½ ½
	OR	
	(b) Length of arc AB = $\frac{1}{4}\times\frac{22}{7}\times2\times21$ =33 cm.	1
	Perimeter of sector OACBO =21+33+21 =75 cm.	1

38 **Case Study – 3**

Totem poles are made from large trees. These poles are carved with symbols or figures and mostly found in western Canada and northwestern United States.

In the given picture, two such poles of equal heights are standing 28 m apart. From a point somewhere between them in the same line, the angles of elevation of the top of the two poles are 60° and 30° respectively.

Based on the above, answer the following questions :

(i) Draw a neat labelled diagram. *1*

(ii) (a) Find the height of the poles. *2*

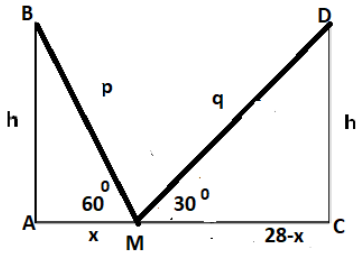
OR

(ii) (b) If the distances of the top of the poles from the point of observation are taken as p and q, then find a relation between p and q. *2*

(iii) Find the location of the point of observation. *1*

Solution

(i) Let AB and CD be the 2 poles and M be a point somewhere between their bases in the same line.



1 for correct figure

(ii) (a)

$$\tan 60^0 = \frac{h}{x} \Rightarrow h = x\sqrt{3}$$ $^1/_2$

$$\tan 30^0 = \frac{h}{28-x} \Rightarrow h = \frac{(28-x)}{\sqrt{3}}$$ $^1/_2$

$$\therefore h = 7\sqrt{3}\ m$$ 1

OR

(ii) (b) BM =p and DM = q

$$\sin 60^0 = \frac{h}{p} \Rightarrow h = \frac{p\sqrt{3}}{2}$$ $^1/_2$

$$\sin 30^0 = \frac{h}{q} \Rightarrow h = \frac{q}{2}$$ $^1/_2$

$$\therefore \frac{p\sqrt{3}}{2} = \frac{q}{2} \Rightarrow q = \sqrt{3}p$$ 1

(iii)

$$\tan 60^0 = \frac{7\sqrt{3}}{x} \Rightarrow x = 7m = AM$$ ½

$$MC = 28 - x = 21\ m$$ ½